WHAT IS CLAIMED IS:

1. A flexible microchannel heat exchanger, comprising:

a device interface layer including inlet and outlet holes and being formed from a first heat-sealable polyimide material;

a header layer formed from a second heat-sealable polyimide material and heat-sealed to said device interface layer, said header layer including ports aligned with said inlet and outlet holes and fluid distribution microchannels in fluid communication with said ports;

a channel layer formed from said second heat-sealable polyimide material and heat-sealed to said header layer, said channel layer including fluid flow microchannels in fluid communication with said fluid distribution channels and oriented differently than said fluid distribution channels; and

a cap layer formed from said first heat-sealable polyimide material and heat sealed to said channel layer.

2. The heat exchanger of claim 1, wherein said first heat-sealable polyimide material has a greater glass transition temperature than said second heat-sealable polyimide material.

3. The heat exchanger of claim 2, wherein said first heat-sealable polyimide material includes a core having said greater glass transition temperature.

4. The heat exchanger of claim 1, wherein:

said first heat-sealable polyimide material is DuPont Kaptonâ EKJ; and

said second heat sealable polyimide material is DuPont Kaptonâ KJ.

5. The heat exchanger of claim 1, wherein the microchannels in said channel layer have a plurality of lengths.

6. The heat exchanger of claim 5, wherein the microchannels in said channel layer have an overall hourglass-like shape, and a waist of the hourglass-like shape aligns with said ports in said header layer.

7. The heat exchanger of claim 1, wherein fluid communication between microchannels in said header layer and said channel layer is established where ends of microchannels in said channel layer intersect microchannels in said header layer.

8. The heat exchanger of claim 7, wherein microchannels or sets of microchannels in said channel layer further from said ports intersect more microchannels in said header layer than microchannels or sets of microchannels in said channel layer that are closer to said ports.

9. The heat exchanger of claim 1, wherein said header and channel layers are thicker than said device interface and cap layers.

10. A flexible microchannel heat exchanger, comprising:

a laminated polyimide structure including a device interface layer, a header layer, a channel layer and a cap layer; and

a three-dimensional microchannel fluid circuit formed by microchannels in said header layer and said channel layer and holes in said device interface layer, wherein intersections of microchannels between said header layer and said channel layer define flow paths between said header layer and said channel layer.

11. The heat exchanger of claim 10, wherein microchannels or sets of microchannels in said channel layer further from said holes intersect more microchannels in said header layer than microchannels or sets of microchannels in said channel layer that are closer to said holes.

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12. A method for forming a flexible microchannel heat exchanger, the method comprising steps of:

mechanically patterning heat-sealable polyimide sheets to define separate device interface, header, channel layers;

preparing the patterned sheets for lamination bonding; and

laminating the patterned sheets together with a cap layer.

13. The method for forming according to claim 12, further comprising a step of cutting the heat-sealable polyimide sheets to size prior to said step of mechanically patterning.

14. The method for forming according to claim 12, wherein said step of mechanically patterning comprises a computer controlled knife cutting.

15. The method for forming according to claim 14, wherein said computer controlled knife cutting is conducted according to a three-dimensional solid model.

16. The method for forming according to claim 12, further comprising a step of mounting the sheets on a carrier prior to said step of mechanically patterning.

17. The method for forming according to claim 12, wherein said step of laminating comprises vacuum hot-pressing.

18. The method for forming according to claim 17, wherein the cap layer and the device interface layer are formed from a higher glass transition temperature polyimide than the header layer and the channel layer

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19. The method for forming according to claim 17, further comprising a step of applying a platen separator to the cap layer and the device interlayer prior to said step of lamination.

20. The method for forming according to claim 12, wherein said step of preparing comprises solvent degreasing.

21. The method for forming according to claim 20, wherein said step of preparing further comprises scrubbing.

22. The method for forming according to claim 21, wherein said step of preparing further comprises rinsing.

23. The method for forming according to claim 21, wherein said step of preparing further comprises drying.

24. The method for forming according to claim 23, wherein said step of preparing further comprises dehydrating.